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(56) Documents Cited

**GB 2257332 A EP 0693861 A2 EP 0464911 A2
US 5408693 A
WPI Abstract Accession No.96-315378/32 & JP
8139663A**

(58) Field of Search

**UK CL (Edition O) H4L LDJ LDLX LDSH LDSX LECX
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(54) Out of range indication for digital wireless systems

(57) A system for notifying users of digital wireless communications that a mobile unit is moving out of range and communication is about to be lost. The system inserts an audible indication as the received signal strength varies. The audible indication can be in the form of noise 90 which is inserted 50 in such a manner that a digital mobile unit mimics the behaviour of an analogue mobile moving out of range, thereby providing a readily identifiable indication to the user that the wireless handset is about to go out of range. The amount of noise added is increased as the signal quality, eg RSSI, decreases. Such a system may be included in both the wireless unit, to indicate to its user, and in the base station equipment, connected to a landline system, to indicate to the land-based user in communication with the wireless unit, that communication is about to be lost.

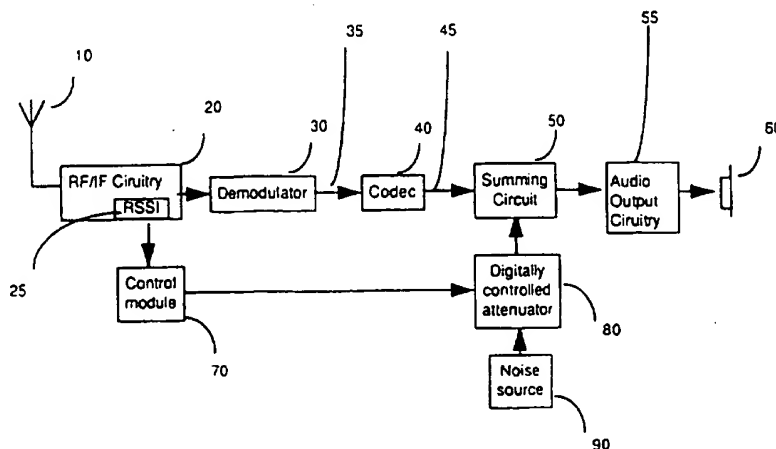


Figure 1

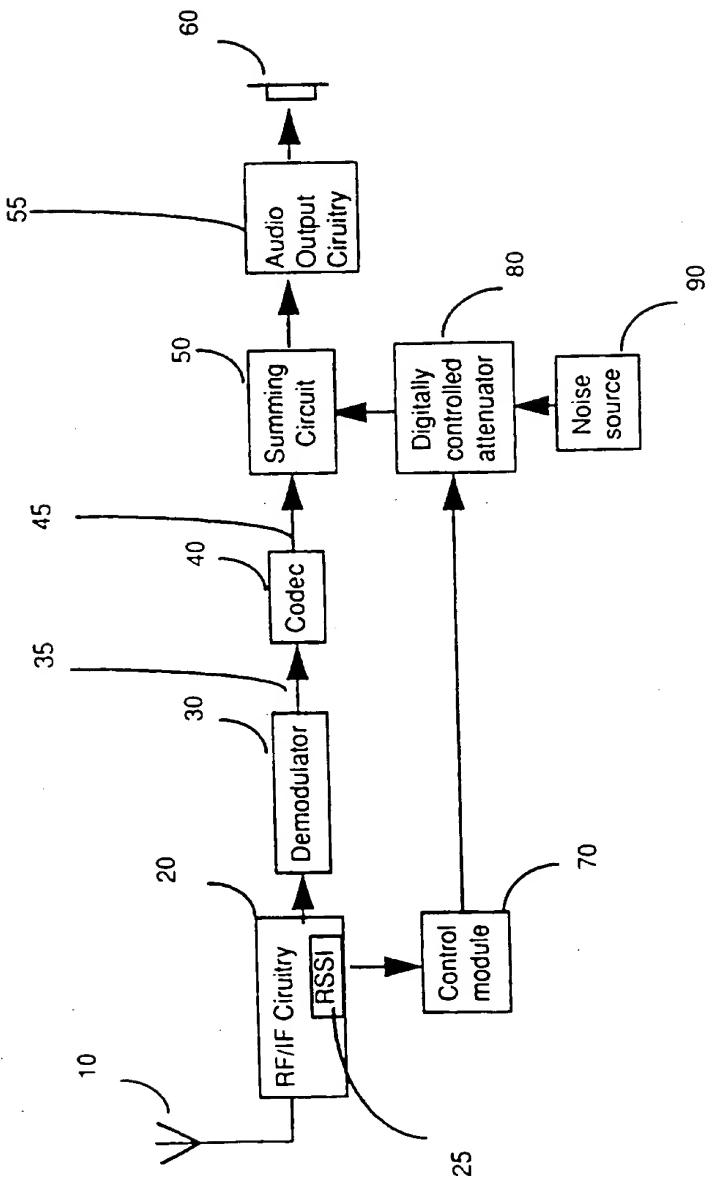


Figure 1

Figure 2

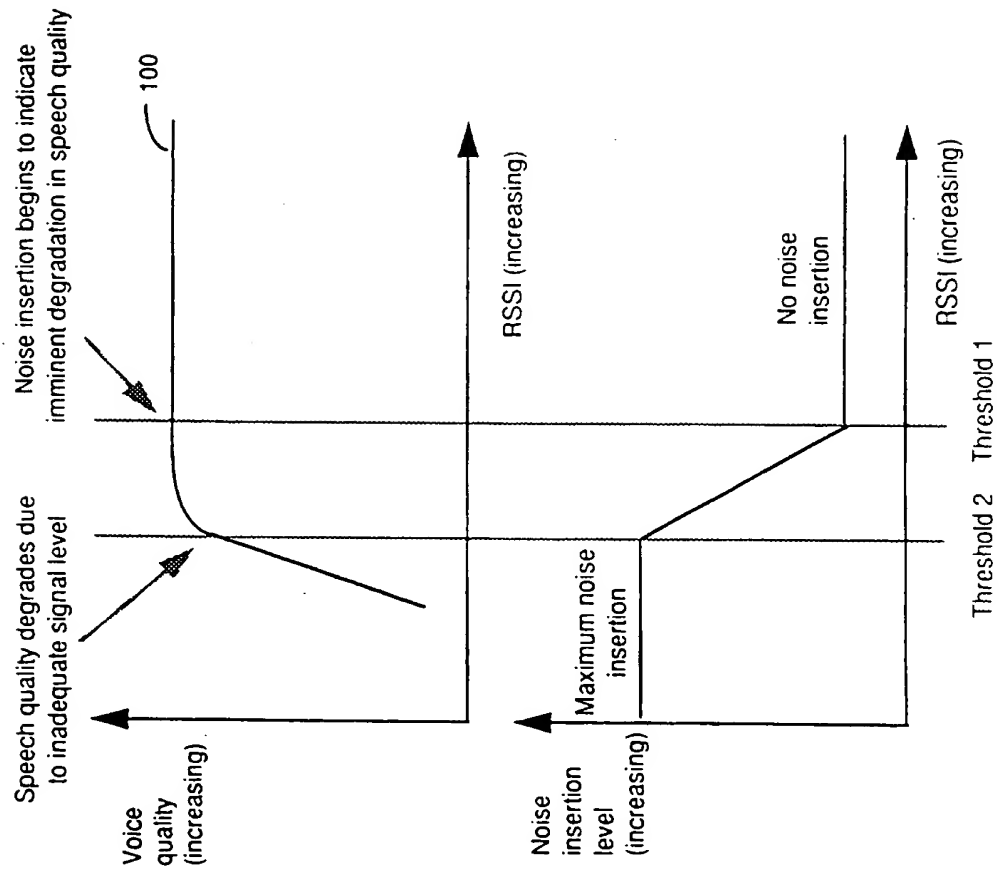


Figure 3

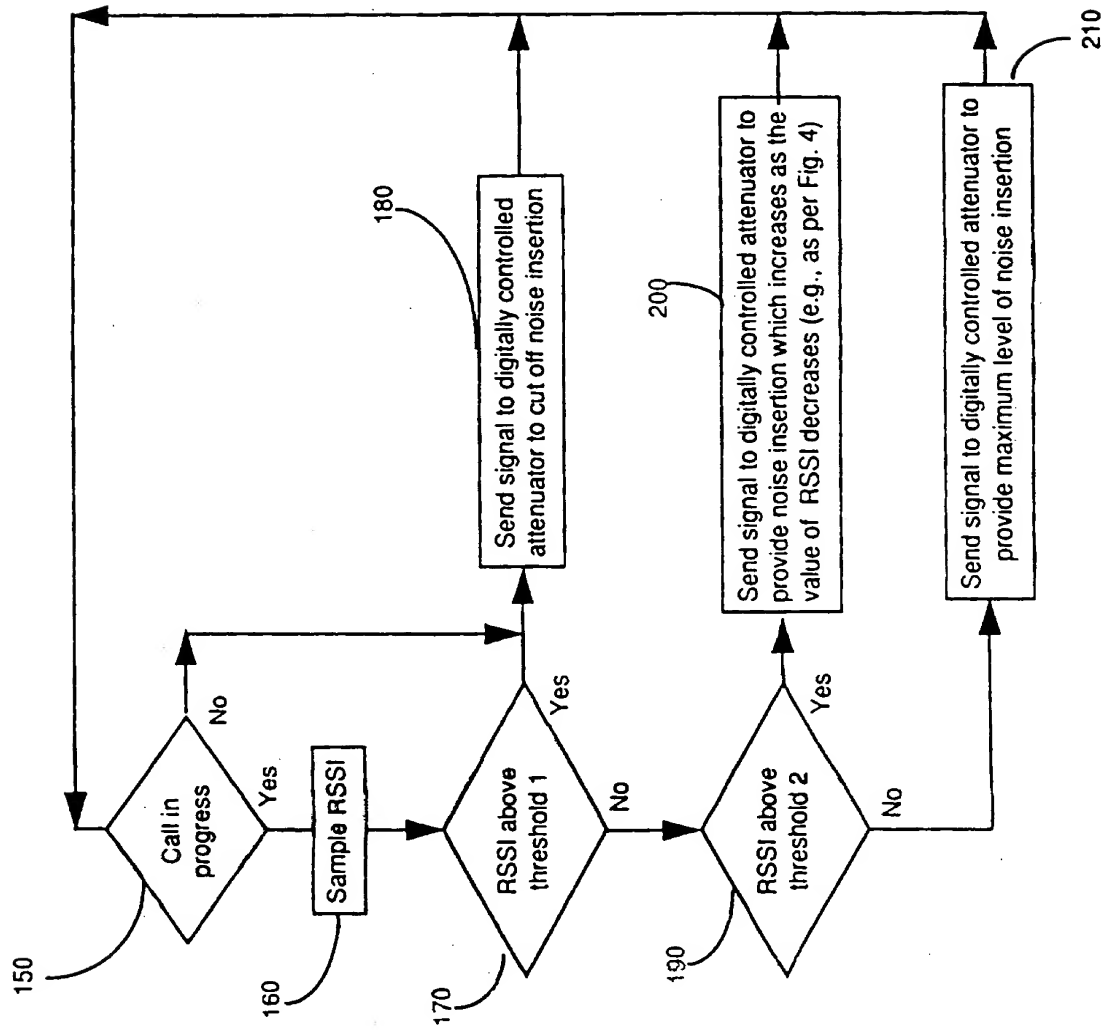
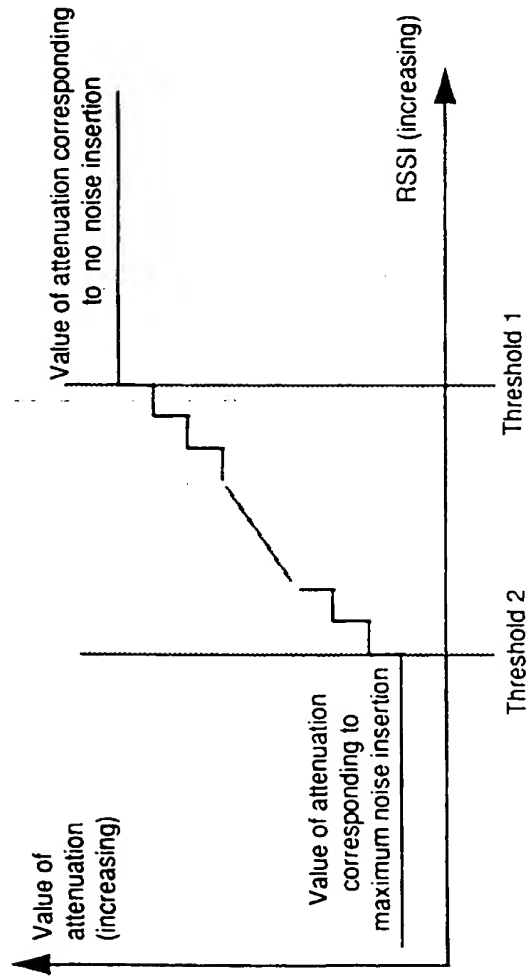


Figure 4



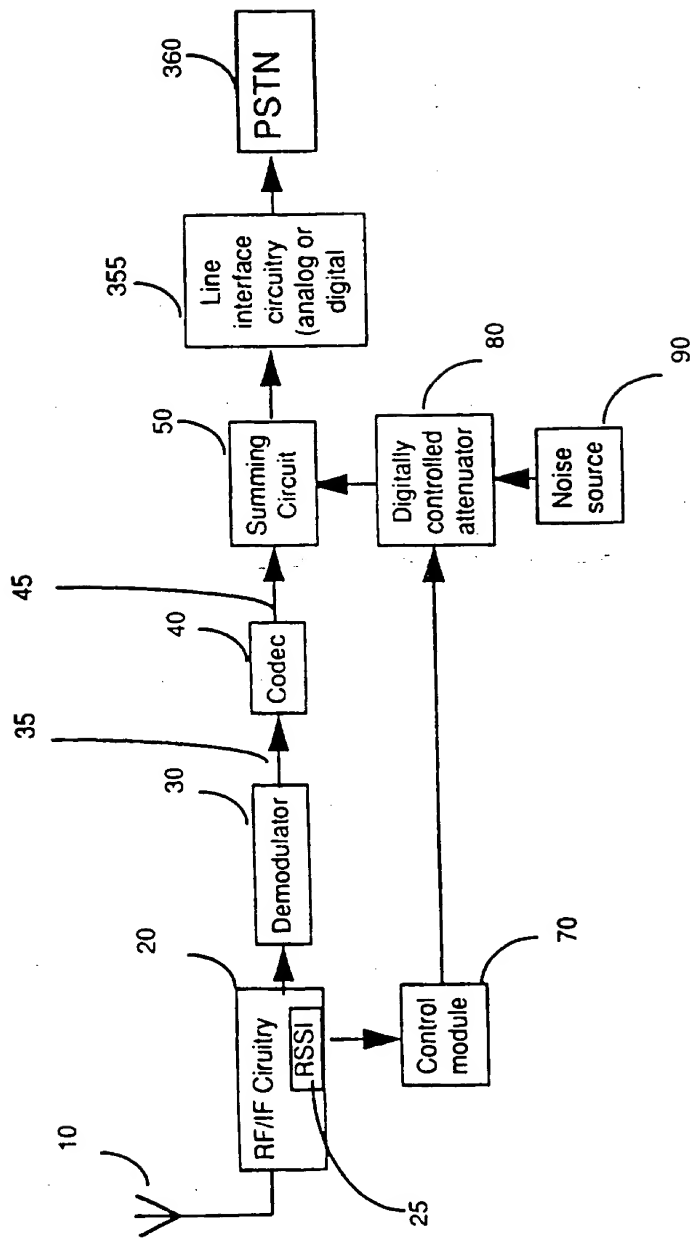
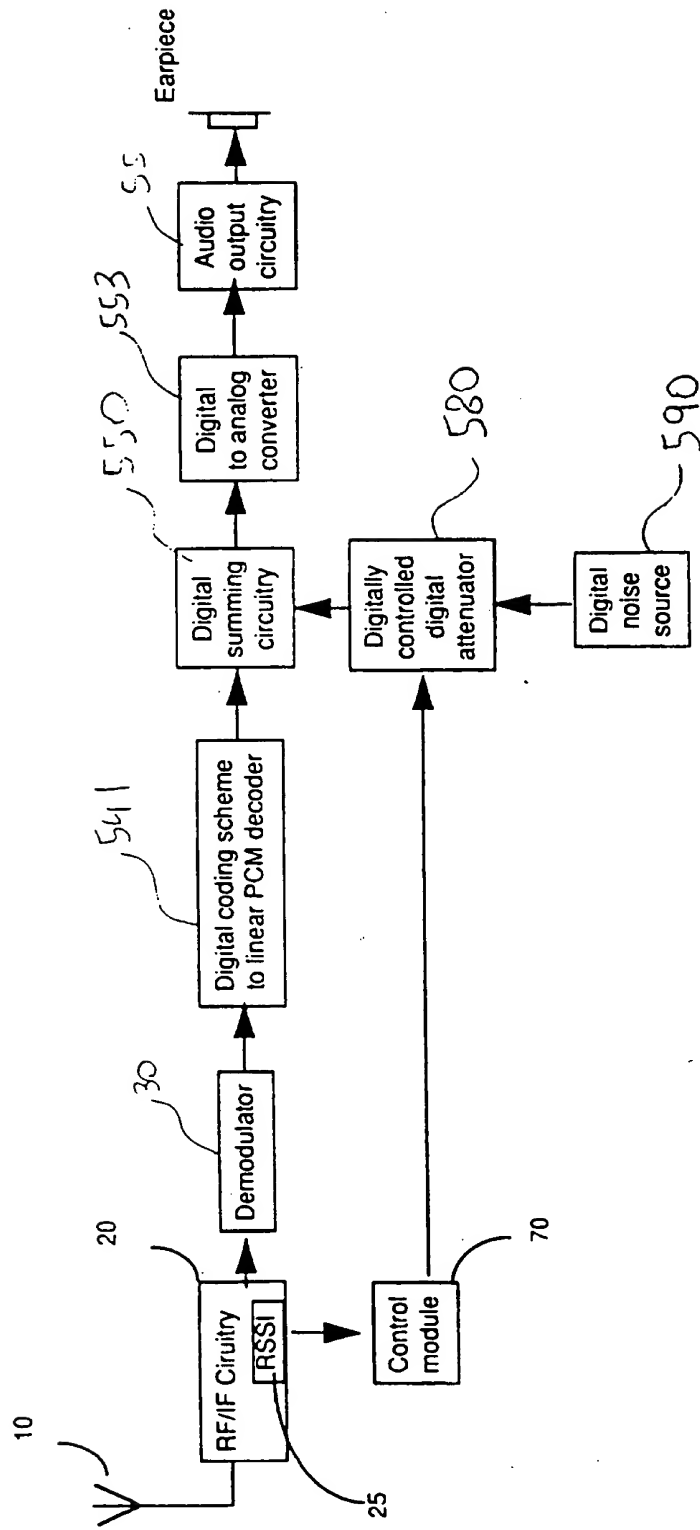


Figure 5

Figure 6



User Out-of-Range Indication for Digital Wireless SystemsField of the Invention

The present invention relates generally to digital
5 wireless systems having out-of-range detection sub-systems.

Background to the Invention

In analog wireless systems, as a mobile unit moves
away from another wireless unit, the audio quality of the
10 voice signal between the two units degrades gradually due
to the reduction in the signal level as the mobile unit
moves out of range. This produces increased noise, which
acts as an audible indicator to the users that the mobile
unit is gradually moving out of range.

15 In contrast, in digital wireless systems, due to the
nature of digital transmissions, audio quality is
maintained at a constant level despite variations in
received signal level as the mobile node moves, provided
the signal level is sufficient to enable the receiver to
20 differentiate between "on" and "off" bits. However as the
mobile unit moves to the limit of the receiver's
sensitivity, the ability of the receiver to differentiate
between "on" and "off" bits, and hence the audio quality,
deteriorates rapidly. This can result in the receiver
25 producing severely distorted speech, or even loud noise
bursts in the user's ear, without any warning to the user.

U.S. Patent 5,408,693 suggests automatically
attenuating the output audio signals whenever a received
signal strength indicator (RSSI) determines that the
30 received signal strength is below a predetermined
threshold. While this reduces the problem of a loud
unexpected noise burst in the user's ear, there still
exists a need for a system which will indicate to a user
that communication may be lost suddenly in the middle of a
35 conversation.

BAD ORIGINAL

It is an object of the invention to provide an indication of the approach of a limit of coverage is being approached which does not result in significant degradation of the audio signal.

5 Summary Of The Invention

According to the invention there is provided a radio receiver comprising: an audio output section, a receiver section for detecting a signal to be received by the receiver, a received signal quality determinater for
10 providing an output according to a received signal quality, an auditory generator, responsive to an output of the received signal quality determinater, for generating at least one audible output by the audio output section indicative of the signal quality in addition to an auditory output derived from the received signal.

15

By providing an auditory output indicative of the signal quality in addition to rather than in combination with the approach of a poor reception area can be indicated without the desired auditory output being masked or otherwise corrupted. Thus, the clarity of the
20 communication remains to the extremes of reception but an indication of the possibility of communication breakdown is also given.

There are a number of ways in which the signal quality may be determined. For example, the strength of the received signal may be
25 used as the quality indication utilising a received signal strength indicator. That is to say, the stronger the signal is the higher the quality is considered to be.

The bit error rate may also be used to provide an indication of the signal
30 quality. The higher the bit error rate that is detected, the lower is the quality of the signal.

A combination of the ways is also possible, for example, a combination of both received signal strength and bit error rate may also be used to
35 generate a quality indication.

The auditory output indicative of the quality may be output at the start of a message, the end of the message or periods of the message that would otherwise be silent or any combination of these. Where the output is provided at the end of the message it will usefully serve as an indication that the message has finished.

Brief Description Of The Drawings

A specific embodiment of the invention will now be described by way of example only with reference to the drawings in which:

Figure 1 is a receiver in accordance with a preferred embodiment of the invention;

Figure 2 is a set of explanatory drawings showing speech output together with pulses which indicate the received signal strength.

Detailed Description Of A Specific Embodiment

With reference to Fig 1 a portable radio transceiver 1 includes a microprocessor 2 linked to memory 3. The microprocessor 2 is also linked to a receiver section 4, a transmitter section 5, an antenna switch 6, a received signal quality determinater in the form of a received strength signal indicator 7, an audio amplifier 8 and an input amplifier 9.

The antenna switch 6 selectively couples the receiver and transmitter sections to an antenna 10 under the control of the microprocessor in a well known manner.

The amplifier 8 drives a speaker 11 whilst the input amplifier is connected to a microphone 12. An analogue to digital converter 13 is provided between the input amplifier 9 and the microprocessor 2. A

digital to analogue converter 14 is connected between the audio amplifier 8 and the microprocessor 2.

5 The operation of the transceiver will be for the most part familiar to the man skilled in the art of radio transceivers. The transceiver 1 is a digital radio transceiver and it is controlled by the microprocessor 2 in accordance with a software program held in the memory 3.

10 Signals received by the antenna 10 are passed to the receiver section 4 where they are detected and amplified. The amplified detected signal are then passed to the microprocessor 2 where they are processed. The processed signals are then converted to analogue form by the digital to analogue converter 14 before being output by the speaker 11. This forms an audio output section,

15 Speech is transmitted in the following way. A user of the transceiver speaks into the microphone 2 and the resultant electrical signal amplified by the input amplifier 9. The amplified signal is then converted by the analogue to digital converter 13 to digital form . The
20 digital signal is processed by the microprocessor 2 and the processed signal passed to the transmitter section 5. here the signal is applied to a power amplifier and the amplified signals passed to the antenna 10 from whence they are transmitted.

25 The received signal strength indicator 7 is of conventional form and it provides a signal to the microprocessor 2 indicative of the received signal strength.

30 As well as the earlier referred to software program, the memory 3 also holds in digital form a strength indicator tone. This tone when passed by the microprocessor 2 via the digital to analogue converter 14 and the amplifier 8 to the speaker 11 will produce an audible tone to indicate to the user the strength of the received signal. Thus these components comprise an auditory generator. The manner in which this is achieved
35 will now be described.

A transmission is received and the received signal strength measured by the received signal strength indicator 7. That value is compared with a set of threshold values by the microprocessor 2 (the threshold values being held in memory 2). This results in a quantification of the strength into six bands from the weakest signal to the strongest signal.

The tone is output before and after the received speech is passed from the microprocessor 2 to the audio amplifier 8 and speaker 11. The number of tones indicates the strength from the strongest signal indicated by five tones to the weakest signal indicated by the absence of a tone.

Figs 2a shows the output from the speaker 11 when the signal is at its strongest. It will be seen that there are five tones t1 to t5 before and after the received speech.

As the signal weakens the number of tones output will fall. Fig 2b, 2c and 2d show the situation when four, three and one tones are output. Fig. 2e shows the situation where the signal is at its weakest and no tones are output with the speech.

In this particular embodiment the variation of signal strength is indicated by the number of identical tones present. In alternative embodiments the auditory significance of the tones may be varied by varying the pitch, frequency or volume to indicate the variation in signal strength. The invention is also applicable to receivers.

In some embodiments it may be desirable to enable a user to configure set the levels to which the tones correspond. Also to avoid annoyance to the user it may be desirable for the tones or other auditory indicators to be output at certain signal levels only. For example, the tones might start to be output only as the received signal strength approaches critical levels. Thus, in normal operation the tones would not be present until the edge of coverage was approached. This might alleviate irritation that a user might otherwise experience.

Claims

5 Claim 1. A radio receiver comprising:
 an audio output section;
 a receiver section for detecting a signal to be received by the
receiver;
 a received signal quality determinater for providing an output
10 according to a received signal quality;
 an auditory generator, responsive to an output of the received
signal quality determinater, for generating at least one audible output
by the audio output section indicative of the signal quality in addition to
an auditory output derived from the received signal.
15

Claim 2. A receiver as claimed in claim 1 wherein the auditory
generator generates a tone or tones.

20 Claim 3. A receiver as claimed in claim 2 wherein the auditory
generator varies the auditory significance of the tone or tones to
indicate the signal quality.

Claim 4. A receiver as claimed in claim 3 wherein the auditory
25 significance is varied by varying the number of tones.

Claim 5. A receiver as claimed in claim 4 wherein the number of tones
varies such that the poorest quality signal has fewer tones than greater
quality signals.

30 Claim 6. A receiver as claimed in claim 5 wherein the poorest quality
signal results in no tones being output.

Claim 7. A receiver as claimed in any preceding claim wherein a tone is output before and after an auditory output derived from the received signal.

- 5 Claim 8. A receiver as hereinbefore described with reference to and as illustrated by the drawings.



Application No: GB 9722005.7
Claims searched: 1-8

Examiner: D. Midgley
Date of search: 22 January 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4L LFM H4P PEX

Int Cl (Ed.6): H04B 1/10,1/16,17/00 H04L 1/20 H04Q 7/32

Other: ONLINE:WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2307623 A (NORTHERN) See, for example, page 2, lines 33 and 34.	1,2
X	GB 2178270 A (OKI) See, for example, page 1, lines 107 -110.	1,2,3
X	EP 0693861 A2 (MITSUBISHI) See, for example, column 5, lines 47-49.	1,2
X	EP 0464911 A2 (PHILIPS) See, for example, column 1, lines 27-43.	1,2,3
X	EP 0310379 A2 (TOSHIBA) See, for example, column 3, line 25.	1,2,3,4

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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